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Increasing Physical Activity of Preschool Students

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INCREASING PHYSICAL ACTIVITY OF PRESCHOOL STUDENTS

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Abstract

Background. Childhood overweight and obesity is a serious health issue. Childhood obesity is associated with asthma, hepatic steatosis, sleep apnea, psychosocial complications, increased presence of cardiovascular disease risk factors, and increased medical costs. A decrease in physical activity, an increase in sedentary behavior, and unhealthy eating likely contribute to childhood overweight and obesity. Over the last 3 decades, the prevalence of early childhood obesity has also risen. The level of physical activity that preschoolers engage is influenced by policies and practices of childcare centers they attend. Given the large number of children enrolled in preschool settings and the variability of physical activity among centers, these environments provide a promising opportunity to engage more children in health promoting levels of physical activity. Preschool students are highly sedentary and very little is known about how to significantly increase physical activity in childcare environments with structured, teacher-led activity.

Methods. Activity levels among children aged 4-5 in four childcare centers were measured before and after a one-day preschool physical activity teacher training by accelerometry for approximately 5 hours per child over two mornings. Observers coded individual child activities by time. Accelerometer measures of activity levels in METs and related indicators were linked at one-minute intervals with child activity codes. Data were evaluated using single-group repeated measures analysis of variance.

Results. After six weeks of implementation the intervention, average MET levels in preschoolers in three of the four centers increased by 11.5% from baseline to follow up. The average MET level per minute for these children at baseline was 2.69±0.40 and at follow-up was 2.98±0.52 (p value= .001). Teachers from all four centers reported spending 24.6 ±13.0 minutes per activity session with up to two sessions completed per day. Teachers reported following the curriculum closely and indicated that the children were generally enthusiastic.

Conclusions. These results justify larger trials to determine the impact of physical activity teacher training on the intensity and duration of preschool students' physical activity in childcare settings

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Comprehensive Literature Review

Childhood Obesity Defined

Obesity and overweight is a serious national and worldwide health issue for both children and adolescents. As defined by the Centers for Disease Control and Prevention (CDC) and based on the 2000 CDC Growth Charts for the United States, childhood obesity is defined as a " Body Mass Index (BMI) at or above the 95th percentile for children of the same age and sex" [1]. BMI is a measure of weight in relation to height to quantify body mass (kg/m^2) in adults and children. However, BMI percentile is a generally accepted clinical measure used to determine obesity and overweight status in children and adolescents (2-19 years old). The BMI value is plotted on CDC growth charts to assess the BMI percentile. In children, obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex. Overweight is defined as a BMI at or above the 85th percentile. Given that body composition for children varies with age and gender, the BMI-for-age percentile is used to determine weight status.

Prevalence of Childhood Obesity

As reported in the 2007-2008 National Health and Nutrition Examination Survey (NHANES), an estimated 17 percent of children ages 2-19 years old in the United States are classified as obese [2]. Obesity rates in school-aged children have tripled over the last 30 years [3,4]. Additionally, it is estimated that among

preschool aged children 2-5 years of age, obesity increased from 5% to 11%, from 7% to 20% among 6-11 year olds, and from 5% to 18% among adolescents aged 12-19, between 1976-1980 and 2007-2008 [2]. Despite efforts to curb childhood obesity, between 2000 and 2008 it was found that there was no significant change in the estimated prevalence of childhood obesity [2]. Additionally, there is significant concern about the prevalence of obesity within certain racial and ethnic groups including African Americans, Native Americans, and Hispanic children [5,6] which are disproportionally affected by the obesity epidemic compared to the general population. Despite the fact that some studies [7] have suggested that obesity prevalence is greater in low income compared to higher income individuals, recent data show that between the years of 1988-1994 and 2007-2008, childhood obesity prevalence increased at all education *and* income levels [8].

The state-based surveillance system, the CDC's Pediatric Nutrition Surveillance System (PedNSS), monitors the nutritional status of children from birth through 4 years old enrolled in federally funded services for low-income families. Currently, PedNSS is the only source of nationally compiled obesity data, unlike NHANES which is designed to *estimate* the health and nutritional status of children in the United States. In 2009, PedNSS reported that 1 in 7 low-income, preschool aged children are classified as obese. PedNSS reported that among low income children obesity in 2 to 4 year olds increased from 12% prevalence in 1998 to 15% prevalence in 2003 [6].

Health Risks

There are several health implications associated with childhood obesity. Obese children are at risk for health problems during childhood and these risks may persist into adulthood. Childhood obesity is an important predictor of obesity in adulthood. Whitaker et al. found that 80% of overweight 10-15 year old children were obese adults at age 25 indicating that childhood obesity is an important predictor of adult obesity [9]. Along with high body mass index (BMI) status (with accompanying implications), physical activity behaviors (sedentary as well as active) have been shown to track from young children into adulthood [10,11].

The health implications of childhood obesity include the increased likelihood of having risk factors for cardiovascular disease including high cholesterol, abnormal glucose tolerance, and high blood pressure [12,13]. Studies have identified an association between childhood obesity and asthma, hepatic steatosis, and sleep apnea [13-15]. Alarmingly, in recent years type 2 diabetes mellitus, rarely previously seen in youth, has emerged with acute and chronic complications among obese children and adolescents [16]. In addition to the aforementioned physical health problems, obese children and adolescents may suffer from psychosocial risks due to early and regular social discrimination [13].

Healthcare Costs

It is estimated that overweight and obesity in 1998 accounted for 9.1% of national health expenditures in the United States [17,18]. The direct costs of childhood obesity are estimated to be $14.1 billion[19] in addition to the inpatient care cost of $237.6 million [20]. Given that approximately a third of obese preschool children and about half of obese school age children become obese adults, one must consider the lifetime cost of childhood obesity. Annually, adult obesity related illness costs the United States health care system $147 billion [21-23].

Etiology of Childhood Obesity

The etiology of childhood obesity and overweight is inextricably linked to imbalances of energy consumption and energy expenditure. Energy expenditure includes thermic effects of food, resting metabolic rate, and physical activity. Physical activity is the most modifiable and variable element of energy expenditure. Importantly, children and adolescents need a slightly larger amount of energy intake than expenditure in order to foster normal development [24]. There is limited evidence that targets specific foods or eating habits as clear contributors to excess energy intake in children and adolescents. However, large portion sizes, eating meals away from home, snacking on energy dense foods and consuming beverages with added sugar are hypothesized to contribute to excess energy intake [25,26].

Physical activity is a key behavioral factor that likely contributes to childhood obesity. Several longitudinal studies have demonstrated that low

levels of physical activity are related to weight status in children [27,28]. Unfortunately, research has revealed that during school hours children may be spending less time in physical activity. Nationally, only 35% of students meet recommended levels of physical activity (60 minutes per day 5 days week). The percentage of adolescent students who attended daily PE classes dropped from 42% in 1991 to 28% in 2003 [29]. A recent review article of 12 observation studies examined the amount of moderate to vigorous physical activity (MVPA) in preschool students, and the body of evidence revealed that preschoolers spend an extraordinary amount of time in sedentary behavior and an inordinately low amount of time in PA [30].

Physical activity is especially important for the health and well-being of children as it offers many immediate and long-term benefits. Notably, physically active children may benefit from positive effects such as improved self-esteem, increased fitness, the prevention of cardiovascular risk factors, and the promotion of bone formation [31,32]. Also, aerobic exercise and physical activity is associated with improved brain and cognitive health across the lifespan [33]. Findings from a recent study suggest that increased an active lifestyle in childhood is associated with "neurocognitive benefits" including improved cognitive control [34].

Congruent with the health benefits of exercise, children who engage in regular physical activity will likely carry these activity habits into the future. Several studies have found that the level of physical activity of school-age children significantly predicts their level of physical activity as adults [35-37]. Given

that physical activity has a tendency to decline as children get older, the results of these studies support the public health promotion of physical activity in children and adolescents [38,39].

Research suggests that children's sedentary behavior increases the risk of developing health problems later in life. Sedentary behavior, especially television viewing, is likely competing with opportunities for physical activity. Several studies have found a positive association between the time spent viewing television and increased prevalence of obesity in children [40-42]. Additionally, research suggests that sedentary behavior has a tendency to track into adulthood and less active children are more likely then active children to become obese adults [43]. Thus, preventing the development of a sedentary lifestyle by reducing television viewing along with other sedentary activities has been identified as a promising public health message to help prevent childhood obesity and associated long term health consequences [42,44].

The factors that influence energy imbalance (genetic, behavioral, and environmental) are multifaceted and highly variable among individuals. Furthermore, it is understood that the relationship between and among these factors causes obesity. It has been theorized that genetics may play a role in the epidemic of obesity. In fact, several family and twin studies have shown that genetic factors may account for 40-70% of the population variation in BMI [45,46]. Despite this, the current obesity epidemic cannot be explained by changes in genetics as it takes tens of thousands of years to alter human genes. Among

obesity experts, there is a general consensus that environment rather than genetics is the predominate cause of the rise of obesity [47,48].

Current public health research is focused on the modifiable aspects of the energy balance equation: environment and behavior. The rising trend in overweight and obesity in childhood has serious public health implications and signifies a national shift toward positive energy balance with both PA and diet representing "behavioral and, therefore modifiable aspects of this balance equation," according to Anzman et al [49]. The environmental factors that influence the balance equation include: the greater community, school, childcare, and family.

The influence of family environment on weight status is well established in the scientific literature. This means that overweight parents tend to have overweight children [9,50]. Additionally, studies have found an association between overweight status and food preferences, eating habits, energy intake, and physical activity in the family [51-55]. Given that both genetic influences and behavioral patterns are passed from parents to children, parental weight status and lifestyle are important predictors of children's risk of obesity in adulthood. Family settings may represent logical targets for intervention trials.

School environments have been identified as important settings to establish healthy habits in children since these institutions have the greatest continuous contact with children over the first two decades of their lives. In fact, as many as

90% of youth aged 5–17 years are enrolled in public schools, representing a model public forum to promote physical activity and healthy eating [56]. Schools can promote physical activity and healthy eating through nutrition education, physical education and recess, and school health services. However, despite national recommendations for both elementary schools and secondary schools, physical activity tends to decline with age, thus likely playing a serious role in childhood obesity [39,57].

Summary of Childhood Obesity

Overweight and obesity in children is a serious health concern for children, adolescents, their caregivers, and for their future adult selves. The health risks, medical costs, and social issues associated with childhood overweight and obesity underscore the importance of early childhood public health intervention. Childhood is a significant stage for the development of obesity, and a time where a decrease in physical activity, an increase in sedentary behavior, and unhealthy eating likely lead to positive energy balance and ultimately overweight and obesity.

Early Childhood Obesity

Obesity and overweight among preschool children has increased dramatically over the last three decades concurrent with increased sedentary activity and decreased physical activity. From 2007-2008 it was estimated that 10.4% of 2-5 year olds in the United States are obese and 10.8% are overweight [2]. Both

inactivity and insufficient physical activity are likely contributing to the growing trend of early childhood obesity [2,58]. Physical activity and TV viewing have been associated more closely with body mass index (BMI) status than diet for 3 to 4 year olds [27]. Exercise habits established in early childhood tend to track into adulthood [43,59]. During the critical developmental stage of early childhood, life-long habits and attitudes are established further emphasizing the impact that preschool settings have on children's physical activity behavior [60]. Given the recognized link between physical activity and weight status in children and adolescents, efforts to establish physical exercise habits in young children are imperative for obesity prevention throughout the lifespan [61].

Prevention efforts in early childhood are critical since obese children 3-5 years of age are more likely to be overweight and obese in adolescence and adulthood [10,21]. It is well known that children and adolescents with obesity are more likely to develop type 2 diabetes, hypertension, and hyperlipidemia. There is emerging evidence indicating that the earlier the onset of these chronic health conditions in childhood, the higher the risk of complications earlier in life [62,63]. Therefore, more and more children may be dealing with obesity related health complications in relatively early adulthood.

Studies suggest that childcare policies influence health related behaviors including physical activity and childcare centers may account for as much as 47% of the variation of physical activity during the school day [64,65]. The National

Association of Sport and Physical Education recommends that toddlers and preschoolers get 60 minutes of structured activity, 60 minutes of unstructured activity, and less than 60 minutes of sedentary activities at a time [66]. Childcare policies regarding physical activity are largely determined by state regulations, with the exception of the federally funded Head Start program. A recent review of state child care regulations related to physical activity and nutrition guidelines revealed that regulations are highly variable from state to state. Only 2 states specify the actual duration of physical activity per day, 9 states suggest a minimum length of outdoor time per day, and no states have a recommendation for the amount of time spent in teacher-guided or free play [67].

Preschool Participation

The number of U.S. children served in preschools has increased dramatically in the last few decades: in 2007-2008, 60% or 4.2 million young children ages 3-5 attended preschool programs [68]. Several studies have identified preschool centers as a promising environment to assist children in reaching and maintaining physical activity goals [60]. This group of preschool establishments holds a particularly powerful potential for health promotion efforts.

Summary of Early Childhood Obesity

Over the last 3 decades, the prevalence of early childhood overweight and obesity has risen and children with obesity are more likely to develop chronic health conditions. The weight status of children has been clearly linked with

physical activity. The level of physical activity that preschoolers engage in is associated with the policies and practices of childcare centers they attend. Given the large number of children enrolled in preschool settings and the variability of physical activity among centers, these environments provide a promising opportunity to engage more children in health promoting levels of physical activity.

Direct Observation Studies of Physical Activity in Early Childhood

Despite the perception that preschool students are constantly moving and receiving the health benefits of physical activity, a number of observational studies in the past few decades report otherwise. Within a preschool day, studies have found high levels (70%-90%) of sedentary activity and low levels of MVPA [64,65,69-71]. These findings suggest that current preschool activity levels do not fulfill the recommendations necessary to support healthy development and establish future health habits. Increased sedentary activity and decreased physical activity are likely contributing to the prevalence of childhood and adolescent overweight.

More specifically, in 2003, Trost et al. [70] sought to evaluate weight-related differences in physical activity for both overweight and non-overweight children during the preschool day. Physical activity of 245 3-to-5 year olds from nine preschools was assessed using a direct observation system for recording activity in preschools (OSRAP) and accelerometry. The researchers found that overweight preschool boys tend to be significantly less active than non-overweight classmates during the preschool day. However, weight status was

not associated with preschool physical activity in girls. Overall, the study results suggested that overweight children may be at risk for further weight gain due to low levels of physical activity during the preschool day.

Using the same observation system, OSRAP, Pate et al. measured physical levels in 493 3-to 5-year old children in 24 preschools and found that children engaged in MVPA for less than 3% of the observation period [65]. In addition to low levels of MVPA, the physical activity during 85% of the intervals was very light or sedentary. The study highlights the sedentary nature of children during much of their time in preschool. Importantly, the researchers also discovered that the preschool attended " was a stronger predictor of physical activity level than any other factor examined." Consistently, observational studies have reported that differences in physical activity levels between preschools vary systematically from one another due to several factors including the preschool environment, policies, and practices [72-77].

In addition to discovering that children's physical activity behavior is significantly affected by the actual childcare setting, Bower et al. found that daycare centers with higher PA scores had teachers with more physical education training [73]. Likewise, Dowda et al. reported that daycare centers scored higher in physical activity levels due to a recent physical education training that stressed the importance of providing more physically active opportunities for children [75].

Summary of Direct Observation of Early Childhood Physical Activity

According to direct observation study results, preschool students are highly sedentary and are getting little moderate to vigorous physical activity during the preschool day. The environmental and educational features of preschool centers are likely responsible for and influence physical activity variability among preschool centers. Teacher-led activities have been identified in several observation studies as a promising approach to increase physical activity of preschool students.

Early Childhood Health Promotion Interventions

Recognizing the benefits and importance of establishing evidence-based health promotion and physical activity recommendations for younger children, several studies have investigated the effectiveness of a range of interventions in a variety of settings. Community, children's homes, and childcare settings (including preschools) represent important opportunities to promote a healthy lifestyle in young children.

Community Interventions

Recently a "multi-setting, multi-strategy" community-wide intervention childhood obesity prevention program with over 12,000 children aged 0-5 and their families was evaluated for effectiveness [78]. Conducted 2004 from 2008, "Romp & Chomp", aimed to increase community capacity building and promote environmental changes in the areas of healthy eating and active play. Measures included the Eating and Physical Activity Questionnaire (EPAQ) a parent-

reported instrument which captured children's information about diet and physical activity levels. After the intervention, investigators reported a significantly lower mean weight, BMI, and BMI z-score in 3.5 year olds and a significantly lower prevalence of overweight and obesity in both the 2 and 3.5 year olds compared to the control groups which were drawn from other communities in the state. The program's effects on obesity related behaviors suggest that this age group is responsive to community-wide multi-strategy approaches to obesity prevention. Despite the particular strength of a large sample size, the study did not utilize sensitive, objective measurements of physical activity, limiting conclusions about the effect of the intervention on physical activity.

Home and School Interventions

A randomized control trial by Reilly et al. assessed the effect of an enhanced physical activity program on obesity prevention in 545 Scottish nursery school children 4.2 years old from 36 nurseries [79]. The intervention included three weekly 30-minute physical activity sessions for 24 weeks delivered by two staff at each school. In addition, an at-home component provided families with a resource package and two simple health education leaflets to compliment the school intervention. Physical activity of 15 randomly selected children at each site was measured by accelerometer (ActiGraph) for 6 days, once at baseline, once at follow-up. Group (intervention versus control) physical activity was not significantly different at 6 months or 12 months. Groups were marginally different

when modeling percent of time in MVPA. Results did reveal higher performance in movement skill tests in intervention children than control children at follow-up (CI 0.3 to 1.3; p value .0027). However, the quality and potency of the "dose" of physical activity that this study applied may have not have been adequate enough to impact overall physical activity or BMI.

Recess Interventions

In a randomized pilot study, Alhassan et al. [80] randomized 33 Latino preschool students from one Head Start program to 60 additional minutes of recess or to control (no additional recess). Researchers found that substantially increasing preschool children's outdoor free play did not increase their physical activity levels. As by assessed accelerometers (ActiGraph), there were no significant differences between groups in counts per minute or percentage of time in sedentary, light, or MVPA for the entire day, during school, or after school. These results suggest that simply increasing outdoor recess time may not adequately increase physical activity for preschool students.

Characteristics of the outdoor physical environment at childcare centers may be associated with children's physical activity. Hannon and Brown demonstrated that portable play equipment added to the preschool playground was associated with higher intensities of physical activity [81]. Activity-friendly equipment (hurdles to jump through, balance beams, etc.) was added to a preschool playground. Physical activity levels were measured with

accelerometers (ActiGraph) for 5 pre- 5 post-intervention days during outdoor play. After the addition of play equipment, both boys and girls significantly increased their physical activity in active MET levels (light, moderate, vigorous, very vigorous) and significantly decreased their sedentary behavior. The results suggest that a simple, adaptable intervention requiring little teacher training, and fairly little expense, is a promising intervention to increase physical activity for preschoolers.

Childcare Based Interventions

A majority of children ages 3-5 are enrolled in some type of a childcare program, so naturally these facilities have been identified as promising prospects for physical activity promotion. Parish et al. sought to determine the effectiveness of a Mastery Motivational Play (MMP) session by measuring heart rate over the course of two 30 minute play sessions in a population of African American toddlers from a full-time, subsidized day care center [82]. Teachers from outside the daycare center (considered to be experts in the area of MMP) delivered MMP sessions. A significant difference in heart rate values (15 bpm) was recorded by an Actiheart monitor on the day children participated in the MMP session, compared to a day with an unstructured free play sessions. Of the structured play session, 71% was spent in vigorous physical activity compared to 31% during free play. An important limitation of this study is that only 4 randomly

selected children were assessed for the effect of MMP and free play on heart rate due to a limited number of heart rate monitors.

In a half-day preschool program during both classroom and outdoor time, Trost et al. reported higher levels of MVPA after the implementation of the Move and Learn Program, a 8-week curricular physical activity intervention that integrates opportunities for physical activity in all aspects of the school day [69]. The teachers and staff in the intervention classrooms completed a 3-hour training session. Forty-two participants, ages 3-5, from two classrooms were randomly assigned to either the intervention curriculum with at least two 10-minute sessions per day or to usual activity. The physical activity levels were measured with accelerometry (ActiGraph) and direct observation over the course of the school day. Over the final two weeks of the program, significant differences in vigorous activity were reported. This study did have a small sample size, and the participants were from the same childcare center, limiting the generalizability of results. These results indicate that including physical activity opportunities during the preschool day holds potential for promoting physical activity in preschool children.

A randomized control trial by Fitzgibbon et al. tested the effects of culturally appropriate weight control intervention, "Hip Hop to Health Jr." on the progression to overweight among preschool minority children [83]. One hundred nine African American children 2-5 years old were recruited from 12 Head Start

centers in Chicago, Illinois; six centers randomly assigned to weight control and six to a general health intervention. The program consisted of 45-minute classes, three times a week for 14 weeks. The weight control condition consisted of; 1) a 20 minute lesson on healthy diet with a supplemental activity and 2) 20 minutes of continuous physical activity all of which was led by specially trained preschool experts. The control condition consisted of classroom activities that emphasized more general health concepts including immunization, safety, and dental hygiene. Children's physical activity frequency and intensity for 14 weeks was measured by parent report for baseline and follow-up. Post-intervention changes between intervention and control groups did not differ significantly in either BMI and BMI z score. Follow-up measures conducted at 1 and 2 years post-intervention and BMI and BMI z-score showed a significant improvement at 1 year (0.06 vs. 0.59 kg/m^2) and 2 years (0.54 vs 1.08 kg/m2) (p=.02). Hip Hop to Health Jr. was effective in reducing trajectory increases in BMI in minority preschool children but was not generalizable to nonminority or higher income populations. Generalizability was constrained due to the implementation of the intervention by specialists rather than using regular classroom teachers to deliver the intervention. The evidence of this study clearly highlights the feasibility and efficacy of using a school-based program that included guided physical activity to slow the advancement of obesity in young children.

In a randomized control trial, Eliakim et al. examined the effects of a 14-week school-based health promotion intervention on body weight, BMI, BMI percentile, body composition, habitual physical activity and fitness in 101 Israeli preschool children [84]. The intervention was comprised of a nutritional and physical activity component; physical activity sessions were 45 minutes per day six days per week and directed by a professional youth coach two days per week; other days were led by a trained preschool teacher. Physical activity was measured using pedometers worn for three consecutive days on two different occasions during a 600-meter run before and after intervention. A significant increase in steps was demonstrated within the entire day in the intervention group compared to the control group (6927±364 vs. 5489 ±284, $p < .003$). Favorable changes were observed in weight, BMI percentile, fat percent, and fitness endurance in the intervention versus controls. An important strength of this study is that the intervention was delivered by preschool staff and not outside professionals. Further study will need to delineate the relative contribution of diet versus exercise on body weight status.

A recent intervention study by Brown et al. evaluated the impact of teacher guided playground activities on the activity level of children enrolled in classrooms in two preschool Head Start programs [60]. The control group participated in normal morning or afternoon recess, whereas the intervention group participated in teacher-implemented outdoor physical activity interventions aimed at increasing MVPA. The games developed by the main author and

interested preschool teacher included relatively brief "Track Team" and "Dance Party" activities designed to increase MVPA in outdoor environments. The OSRAC-P direct observation system was used to measure physical activity. The investigators reported an increase in MVPA during teacher-guided activities compared to days with no teacher-guided activities. This study had apparent limitations given the restricted sample size (5), classes (4), activities (2), and location (outdoors). The simplicity, ease, and impact of this intervention highlights the practicality of including brief periods of teacher-led physical activity designed to increase MVPA during the preschool day.

Summary of Preschool Health Promotion Interventions

Studies have identified a number of possible targets including community-wide health initiatives, home and school interventions, healthy diet curricula, and preschool physical activity programs. Because a large number of children are enrolled in child care settings, physical activity interventions directed at these facilities have the potential to impact the amount and duration of physical activity these children receive. Within the preschool environment, researchers have evaluated the impact of recess, specialized play sessions, weight control, health promotion interventions, duration and level of physical activity, and weight status. From this collection of studies, teacher-guided activity interventions have emerged as a promising avenue of future research.

Literature Limitations

The area of early childhood physical activity promotion is still in its infancy and factors that influence physical activity in early childhood are multifaceted and complex. Further evidence is needed to more fully understand which potential interventions are most effective in encouraging healthful levels of physical activity in preschool children. According to studies, teacher-led activity holds promising potential to effectively and practically increase physical activity in preschool children. However, there is insufficient evidence to determine if teacher-led interventions have a positive impact on physical activity engagement due to several limitations.

For example, in a randomized control study by Reilly et al., the dose of physical activity intervention was ineffective in increasing children's activity levels. Carefully designed interventions could significantly boost MVPA and reduce sedentary physical activity. In a study by Silva-Sanigorski et al., the measurement instrument (parent-report) lacked the sensitivity to accurately measure physical activity. Activity outcomes could be stronger with consistent measurements of physical activity such as sensitive, multidimensional accelerometers. These investigators failed to delineate the relative contribution of diet and exercise on weight status. The ability to attribute changes in physical activity to particular interventions in multi-strategy trials would be of great benefit to future public health initiatives. Repeatedly, preschool physical activity

intervention studies were constricted by small sample sizes and numerous constraints on generalizability. These limitations included intervention implementation by outside experts and homogenous study groups. Future studies may enhance generalizability with larger sample sizes, more diverse subject groups, and functional implementation of interventions by preschool staff. Research that strives to successfully develop, identify, execute, and evaluate teacher-led physical activity interventions for preschool children is justified.

Discussion

Recognizing that early childhood is a vital opportunity to increase physical activity and establish healthy habits, several studies have investigated a multitude of factors that affect early childhood physical activity in a variety of settings. Realizing the benefits of physically activity and the chronic disease risk associated with childhood obesity and overweight, researchers have just begun to investigate the effectiveness of teacher-led physical activity. Although randomized trials have not demonstrated that teacher-led physical activity definitively increases preschool physical activity, observational and pilot data provide a strong case for further investigation. Investigation would aid policy makers, educators, and researchers in developing recommendations and curricula to promote high-quality preschool programs for young children and their families.

Conclusion

Given the myriad of individual and social costs of obesity, it is not surprising that the topic of early childhood physical activity and obesity prevention is a burgeoning focus of research. Brown et al. appealed to researchers to investigate “how to develop, disseminate, and diffuse evidence-based physical activity interventions to early childhood educators[85]." If training to preschool teachers in physical activity education could promote healthful exercise habits and healthy weight status in children, then early childhood physical activity recommendations would be easier to attain. Everyday 13 million children in the United States attend a preschool program and virtually nothing is known about how to increase physical activity. Further investigation into the impact of teacher-led physical activity is warranted to assist preschool students get the recommended amounts of physical activity, decrease sedentary activity, and foster a lifetime of health

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The following Specific Aims and Hypotheses were developed based on a literature review of observation and intervention studies of preschool children's physical activity levels and the impact of teacher-led physical activity. No studies have been published examining the impact of a preschool teacher training on the intensity and duration of preschool children's physical activity.

Specific Aims

1. Identify a preschool physical activity curriculum.

2. Train preschool teachers in a physical education training.

3. Implement the curriculum in four childcare centers.

4. Evaluate change in physical activity in children.

Hypothesis

A teacher-led, physical activity intervention will increase the time and intensity of preschool children’s physical activity.

Abstract

Background. Preschool students in childcare programs are typically sedentary and little is known about methods to increase child physical activity in these settings.

Methods. Activity levels were measured among children aged 4-5 in four childcare centers by accelerometry for approximately 5 hours per child over two mornings before and after an intervention. Activity levels in METs were linked at one-minute intervals with child activity codes recorded by observers. The intervention was a one-day physical activity teacher training in a program designed for these settings followed by six weeks of classroom implementation by these teachers.

Results. Average MET levels among preschoolers in three of the four centers increased by 11.5% from baseline to follow up. The average MET level per minute for these children at baseline was 2.69±0.40 and at follow-up was 2.98±0.52 ($p < .001$). Teachers from all four centers reported spending 24.6 ±13.0 minutes per activity session with up to two sessions completed per day. Teachers reported following the curriculum closely and indicated that children were generally enthusiastic.

Conclusions. These results indicate the feasibility of increasing child physical activity in childcare settings and suggest further work to determine the generalizability of this approach.

Childhood obesity rates have tripled since the 1980's. In 2007-2008 10.4% of 2-5 year olds were estimated to be obese and 10.8% were estimated to be overweight [1,2]. The rising trend in overweight and obesity (O/O) in early childhood has serious public health implications. This trend signifies a national shift toward positive energy balance with both physical activity and diet representing "the behavioral and, therefore modifiable aspects of this balance equation" [3]. Several longitudinal studies have demonstrated that low levels of physical activity are related to weight status in children [4,5].

Adequate physical activity is important for more than obesity prevention in young children. The many positive health outcomes related to regular physical activity include increased self-esteem, fitness, brain and cognitive health, promotion of bone formation, and reduced cardiovascular risk factors [6-8]. Health related habits formed during childhood such as healthy eating and exercise habits likely persist into adulthood [9-11].

In 2007-2008, 60% or 4.2 million children ages 3-5 attended preschool programs. Research indicates these environments may play a pivotal role in helping children attain adequate physical activity levels [12,13]. Despite the perception that preschoolers are constantly moving during the preschool day, evidence suggests that children in this age group are not getting the recommended amounts of physical activity (PA). A recent review by Reilly [14] revealed that preschoolers spend an extraordinary amount of time in sedentary

behavior and a low amount of time engaged in moderate to vigorous physical activity. Within a preschool day, individual studies have found high levels (70%-90%) of sedentary activity [15-17]. These findings suggest that the current level of PA that preschoolers are engaged in does not fulfill the recommendations necessary to support healthy development as established by the National Association for Sport and Physical Education (NASPE) (60 minutes structured activity, and 60 unstructured activity) [18]. Other groups in the United States have recommended a range of variations on these in preschool physical activity recommendations [19].

Studies have investigated the effectiveness of several physical activity promotion interventions for younger children. These studies employed approaches including increased recess time, health promotion programs, weight control programs, play equipment; play sessions, and teacher-guided physical activities in classrooms or on playgrounds [13,20-28]. Several of these studies found positive intervention effects including increased physical activity levels, higher mean heart rate, higher physical activity ratings, and more time spent in vigorous and moderate to vigorous physical activity (MVPA).

Key physical activity promotion targets have been identified as a result of prior research, including physical environment, center policies, staff training, and opportunities for increasing physical activity throughout preschool curricula [19]. The association between teacher-guided physical activity and the intensity,

duration, and contextual aspects of physical activity has been the focus of just a few studies [21,22]. Since preschools are emerging as important health promotion settings, there is a need for stronger evidence that teacher trainings in promotion of physical activity can help preschoolers advance towards physical activity goals. Although recent studies and public health initiatives have highlighted the value of increasing overall physical activity levels in early childhood, little is known about how to significantly increase physical activity in childcare environments with structured, teacher-led activities. A few cross-sectional studies have shown that staff training in physical education is positively associated with children's physical activity [21,29]. However, to our knowledge, intervention studies have not succeeded in showing a positive effect of a focused teacher training on physical activity of preschool students [19,30]. The failure to detect change has been hypothesized by previous investigators to be related to poor quality training of the preschool providers.

Therefore, the current study sought to increase physical activity in preschool children enrolled in childcare centers by training childcare providers to deliver a widely available, high quality preschool physical activity curriculum. We hypothesized that a preschool, teacher-led, physical activity intervention would increase the time and intensity of children's physical activity.

Methods

Study design. This 10-week study used a pre-test / post-test design. In the two-week pre-test period baseline assessments of participating children's physical activity levels were completed with the centers' prior knowledge during typical mornings over two days in each of the four participating childcare centers. The intervention was a teacher training in a preschool physical activity curriculum. The teachers implemented the curriculum for six weeks and kept logs of the components implemented. During the two weeks after the intervention period follow-up assessments of children's physical activity levels were conducted with the centers' prior knowledge. Process data collected during and after the intervention period from teachers and observers documented curriculum implementation and acceptability. The study was approved by the Committee on Human Research in the Behavioral Sciences at the University of Vermont.

Participants and setting. The study was conducted at 4 licensed childcare centers (CC) in Chittenden County, Vermont. Potential CCs were selected with consideration of the number of children available in the targeted 4-5 year age group, the amount of space available to feasibly implement the CATCH Early Childhood (CEC) program activities, absence of a significant physical activity asset such as a gym or a pool at the facility, and diversity of the populations served. Enrollment of CCs occurred from December 2009 to January 2010.

All children ages 4-5 enrolled in the selected centers were eligible for the study. Participating CCs provided consent forms and letters to parents of 4-5 year-old children describing the study and data collection procedures. CC directors were offered an incentive of $400 for participant recruitment and study participation, in addition to staff training and equipment needed to implement the curriculum.

Intervention. The CEC is based on the grades 3-5 Coordinated Approach to Child Health (CATCH) elementary education program [31]. The CATCH program uses Social Cognitive Theory to promote positive changes in multiple health behaviors, including physical activity. The CEC program was piloted in Head Start centers in Houston, Texas; preliminary evaluations demonstrated feasibility and acceptability among children, teachers and parents [32]. For this study, CEC PA components of the curriculum were used which are aimed at increasing moderate to vigorous physical activity through classroom activities enhanced with play equipment, and stimulated by music and group games. The CEC program also emphasizes behavior management strategies to help the students transition smoothly from one activity to the next. A central feature of the CEC curriculum is an activity box containing 5" x 8" cards with concise information and instructions for teachers to implement the program. Table 1 provides a description of each activity category and examples of activities from each content area.

Staff teaching 4-5 year old children from the enrolled CCs participated in a one-day CEC curriculum training conducted by a CATCH/CEC National Training Staff member. Each participating center received the CEC physical education curriculum kit and accompanying equipment (e.g., bean bags, jump ropes). Participating preschool teachers were asked to teach at least two CEC curriculum activity sessions per day during the six-week intervention period (~60 minutes per day).

Measurement

Measures used to document impact, implementation, and acceptability of the CEC program included objective measures of physical activity, observer reports, and logs and surveys provided by participating teachers.

Physical activity measurement. Physical activity was measured with a SenseWear®Pro 3 armband (SWA). SWA assessed physical activity levels over time as average metabolic equivalent of task (MET) and level of PA per minute. The device is worn on the triceps of the upper right arm and held in place by a Velcro armband strap. It uses a combination of five sensors, including a two-axis accelerometer, plus participant's height, weight, and age to calculate total energy expenditure, active EE, average MET levels, number of steps, and sleep and lying down duration for each minute of use. The SWA has been tested in a variety of adult populations and has been validated in resting state, during exercise, and in obese individuals [33]. The outputs of interest for this study

included physical activity by average METs and MET levels: sedentary (1-3 METS), moderate (3-6 METS), vigorous (6-9 METS), and very vigorous (>9 METS) [34]. For both baseline and follow up, we requested that the children wear the armbands for ~8 hours over the course of two mornings.

Direct observation of children's activities. The objective of the direct observations was to record a sequence of activity categories for individual children delimited by specific times that could be linked with minute-by-minute accelerometer measures of activity levels for the same children over these time periods. Trained project staff conducted direct observations. Observers recorded a brief description of each of the 4-5 child participants they were following on a structured form. Observers then recorded the time each new type of activity began throughout the observation period. If child C colored for 10 minutes starting at 8:35 then ran around playing with a ball, for example, this was recorded as: 8:35, C, coloring; 8:46, C, playing with ball.

The observer used the structured form to record whether the activity was indoors or outdoors, and whether the activity was, in general, a teacher-guided activity or free-play activity. In addition, observers took detailed notes about the specific type of activity. After the observation session, each specific activity was further categorized by additional codes indicating whether the activity was free play with a gross motor emphasis (FGM), teacher-led gross motor (TGM) play, or manipulative, sedentary, sedentary with limb movement, transitional, or unique

activities. These categories were adapted from Brown *et al* [35]. The FGM category, for example, included free play outdoors, free play on the playground equipment, and free play in the classroom. TGM included activities such as dance class or an outdoor walk, and most of the CEC activities. A review by Pate *et al.* indicated that both direct observation systems and accelerometry are well established, valid, and reliable measures of physical activity in young children [36]. These systems were noted to be complementary because direct observation data gives environmental and activity context to the accelerometer data.

Height and weight. On the first day of baseline measurements at the CCs, anthropometric measures were taken with children wearing street clothes and without shoes. Research staff used a calibrated floor scale to measure body weight; height was measured using a wall-mounted tape measure with square on head. Body Mass Index (BMI) was calculated as weight (kg)/height (m^2) and BMI-for-age percentile was calculated using standard growth charts to determine the percentage of overweight or obese [37]. CC employees provided age and gender data for participating children.

T**eacher logs and post-intervention surveys.** Participating teachers completed a daily log of CEC lessons used and lesson duration during the 6-week curriculum implementation. They indicated how closely the activities were followed using a scale where 1=not all and 4=completely. Children's level of

enthusiasm in response to the activities was also recorded using a scale where 1=not at all enthusiastic and 5=extremely enthusiastic. Teachers also were asked to complete a semi-structured post-intervention survey regarding the acceptability and ease of implementation of the CEC curriculum.

Observer reports. Two external observers visited participating classrooms during the CEC implementation period with the centers' prior knowledge. An early childhood physical education teacher and a research staff member observed the participating classrooms one half day in each center on alternating days. The physical education teacher served in the role as a consultant to teachers for implementation of the CEC program, but also provided an observer report for each visit. The research staff member directly observed the intervention implementation using a form adapted from CEC evaluation materials 2-3 weeks after the training.

Data reduction and statistical analysis

Data from the SWAs was downloaded into individual files for each participant for each observation session. Demographic data were linked with individual data exported from the SWAs and data were analyzed by proprietary InnerView Research Software (version 6.1) provided by the SWA manufacturer. Observation data (e.g., indoor/outdoor, guided/free play) was hand coded and linked by time stamp to SWA data.

Continuous variables are reported as means ± standard deviations;

categorical variables are reported as frequencies and percents. The analytic approach was a single-group repeated measures analysis of variance. For analysis of baseline-to-follow up intervention changes, time point was considered a fixed effect, with random variables included to account for the correlation among repeated measures taken on the same child as well as the correlation among children clustered within a daycare center. These analyses included only those children with data collected in both time points. All analyses were performed using SAS, version 9.2 (SAS Institute Inc., 2002).

Results

Participant descriptions. Of 46 children with signed parental consent forms, 42 (89%) participated in the study. Among participating children, 32 (80%) completed both baseline and follow-up measures. The mean age of participating children was 4.3±1.5 (range: 4-5) years; 46.3% were male. These participants had an average BMI of 15.9 kg/m^2±1.1; 2.4% were obese, and 12.2% were overweight. A completer verses non-completer analysis revealed that there were no significant differences in age, gender, BMI, or baseline activity levels between children who completed all measures and those who did not. Therefore, analysis focused on children completing both pre and post measures (n=32). Reasons why consented children did not complete assessments included temporary absence and leaving the CC. Seven preschool teachers from the four enrolled CCs participated in the CEC training, implemented the program in their

classrooms, and completed a survey assessment of the curriculum at the end of the follow-up period. Five of these teachers logged the frequency, duration, and type of each CEC activity implemented.

Baseline physical activity measurement. Overall, an average of 332±91 minutes of physical activity was recorded at baseline and 339±72 minutes in follow-up (n=32) per child. At baseline, an average of 57% ±17% of time was spent sedentary and an average of 43% ±17% of time was spent in moderate to vigorous physical activity (n=32). The average MET levels for FGM (n=31) were 3.76 ±.83 and 4.21 ± 1.03 for TGM (n=17).

Physical activity level changes for all four centers. The average MET level per minute among children participating in both assessments in all four centers (n=32) at baseline was 3.00±-0.62 and at follow-up was 3.10±-0.49 ($p < .0001$). This represents a 3.33% increase in average MET levels from period 1 to period 2. Examination of average METs for each center at baseline and follow up, showed that three of the four centers experienced a substantial increase in MET levels (Table 2). One center was removed from further analyses to examine the effect of the intervention on CC with a more typical approach to TGA (Table 2).

Physical activity level changes for centers 1, 2, and 4. In these three CC, 21 children participated at both baseline and follow up assessments. The average MET level per minute for these children at baseline was 2.69±0.40 and at follow-up was 2.98±0.52 ($p< .001$). This represents an 11.5% increase in average MET

level from baseline to follow up among children in these CCs. At baseline, these children spent an average of 66% of the recorded time in sedentary and 32% in moderate activity; negligible amounts of time were spent in vigorous or very vigorous activity (.006%). Favorable changes in time spent in MET levels were noted at follow-up as shown in Figure 1.

Further analyses indicated that the average time spent in specific activity types differed between the two assessments in these three centers. Notably, TGM, the focus of the CEC, increased by 44 minutes and sedentary time decreased by 26 minutes as shown in Figure 2**.**

Teacher assessment logs and surveys. Teachers from all four centers reported spending 24.6 ±13.0 minutes per CEC session with up to two sessions completed per day. Teachers reported following the curriculum closely (3.15 where 1=not at all and 4=completely) and indicated that the children were generally enthusiastic (3.94 where 1=not enthusiastic and 5=very enthusiastic). Six weeks of activity sessions were reported by centers 1, 2, and 4 and center 3 reported 5 weeks. Center 2 reported at least one CEC session over all 30 days; center 1 and 4 missed one day of CEC sessions; center 3 did not complete any CEC sessions for a total of 11 of the 30 days.

Teacher assessments of children's responses reported in the post-intervention surveys were generally positive. Children were reported to be enthusiastic about the activities and the variety of fast paced games and cool

down activities. Teachers reported that the program made their work easier. Several reported that children had “increased attention spans for their classroom work”. Others mentioned that the focus on listening skills and leadership roles stimulated ideas for learning. Teachers reported that the CEC curriculum reinforced the value of incorporating vigorous activity into each day. Teachers were generally enthusiastic about the training with an average score of 8.1 on a 0-10 scale.

Observer reports. The physical education observer reported that all children participated in activities, but not all children seemed to be active during CEC activities in two centers. The two centers reported to be the most active had a large indoor space for movement. The second observer reported a total of 7 observations, indicating that most children were encouraged to be physically active all or most of the time; during six sessions half or more of the class was engaged in physical activity for at least 80% of the time; and all children appeared to enjoy the activities. Teachers seemed to be enthusiastic about the activities all or most of the time. Most teachers both participated in the physical activities and gave the children clear instructions. For all centers, the transition time from one activity to the next was minimal and there was always an adequate equipment ratio for each child.

Discussion

The overall findings suggest that training preschool teachers to use a focused physical activity curriculum was a feasible and effective approach to increasing physical activity among preschool students. During the 6 weeks of implementing CEC, the teachers logged at least 25 minutes of recommended activities per day and reported high levels of enthusiasm by the students. Physical activity increased significantly after the intervention in all 3 centers. Staff observers reported high levels of participation by the children and the staff in the CEC curriculum.

This is the first intervention study that we know of to assess the impact, feasibility, and implementation of a focused preschool physical activity curriculum by training a group of preschool teachers. The influence of this intervention on the level of physical activity in preschool children was assessed with a sensitive multi-sensor armband accelerometer and direct observation. We found a high level of sedentary activity among preschool students (66.6% without center 3) that resonates with previous findings describing preschool children as sedentary for a majority of the preschool day [16,35,38].

As recorded by SWA, on average during the baseline period, all 4 centers were sedentary for more than half of the time and less than one percent of the time was spent in vigorous or very vigorous activity. When center 3 was removed from the analyses, we discovered that the centers spent on average almost

seventy percent of the preschool day in sedentary behavior. Furthermore, after the intervention average MET levels increased by approximately twelve percent for the remaining 3 centers.

Center 3 already had high physical activity levels and the impact of the intervention negatively impacted physical activity levels. Based on research staff observations, the teacher survey, and the written mission of the center which emphasized health, wellness, and fitness, we conclude this preschool program highly valued physical activity and was less likely to benefit from the intervention program.

During the follow-up period, observer reports indicated that about half of the CCs children did not seem to be engaged in MVPA during the CEC activities. However, as seen in the SWA outputs at follow-up, we still saw a significant rise in average MET levels several weeks later. Perhaps because the accelerometer measurements and direct observations occurred six weeks after the CEC training and observation reports occurred 2-3 weeks after the training, the staff had more time to practice and implement the program. Observers also reported that space limitations in the CCs may have been associated with less active play. The amount of play space in childcare settings has been identified as one of many possible environmental determinants of physical activity levels for children attending childcare [13,21].

Although we requested that teachers incorporate at least two sessions of CEC per day, most did not reach this goal. As the NASPE guidelines suggest that children get 60 minutes of structured physical activity per day, we hoped that they could achieve this goal with two CEC sessions during the preschool day. However, as indicated by teacher logs, on average they were able to achieve about half of this goal. This deficit may be explained by the challenge that teachers faced in engaging the children for the recommended structured physical activity time. If these results reflect limitations to increasing PA in these settings, perhaps parents and other programs could fill the missing gap in structured activity for this age group.

A remarkable strength of this study was that very little research has focused on physical activity curriculum interventions for preschoolers. Considering detrimental health implications of a sedentary lifestyle for children and the rise in childhood obesity, this remains a critical area of research. Another key strength of this study was use of multiple methods of evaluation: objective, observational, and self-report to assess the context, duration, acceptability, feasibility, and intensity of physical activity during the school day. Direct observation has been commonly used to measure physical activity in preschool students in conjunction with accelerometry; however, this is the first study to use a multi-sensor armband accelerometer to quantify the impact of a physical activity training program on physical activity levels attained during the preschool day. The physical activity program was delivered by preschool

teaching staff rather then research staff or outside professionals, highlighting the feasibility of a one-day teacher training as a means to increase physical activity in preschool students. The post-test measurements were completed after the end of the follow-up period; the positive changes observed after completion of the formal follow-up period suggested that the impact of the training and curriculum enhancements provided by the teacher training intervention could be sustained.

There where a few limitations to this study. The sample size was small, limiting our ability to detect differences between baseline and follow-up measurements as statistically significant. Loss during follow up contributed to this limitation although it may be typical for this population. Another limitation was the short duration, as an average of 12 hours of observation per child over a limited time frame may not be sufficient to observe other factors that influence preschool physical activity, such as seasonal effects. This study drew from a convenience sample population that may limit our ability to generalize results. Finally, although we did not collect ethnic or racial information, we are aware that overall the Vermont ethnic/race distribution is largely homogeneous which could also limit generalizability; it should be noted, however, that the CEC was developed in settings with more diverse populations.

Considering the detrimental health implications of a sedentary lifestyle for children and the rise in childhood obesity, this remains a critical area of research,

but little research has focused on physical activity curriculum interventions for preschoolers. The major findings of this study were that after six weeks of implementation, a one-day CEC preschool teacher training intervention increased average MET levels in preschoolers by over ten percent. Additionally, preschool teachers reported a high level of satisfaction and efficacy in implementing the CEC program and perceived their students to be enthusiastic about the program. These results suggest that larger trials could provide stronger evidence for the impact of a CEC teacher training on the intensity and duration of preschool students' physical activity in childcare settings.

Table 1 CATCH Early Childhood Activity Categories

I. Warm-up	Short 3-5 minute activities designed to prepare for more vigorous movement
II. Go Fitness	Intended to promote muscular strength, muscular endurance, and cardiovascular endurance
III. Go Activity	Activities that develop fundamental motor skills and rhythm
IV. Limber Limbs	Purposeful movement to improve muscular range of motion such as stretching and twisting
V. Cool Down	Cool down students' bodies and help with transition back to the classroom

Table 2 Average MET levels and time spent in MVPA per center for all children

	Baseline			Follow-up		
Ctr	**n=**	**METs mean ± SD**	**Time in MVPA mean ± SD**	**n=**	**METs mean ± SD**	**Time in MVPA mean ± SD**
1	10	2.69±0.36	120.50±63.28	9	3.02±0.59	150.11±61.03
2	6	2.54±0.42	50.66±31.61	4	2.57±0.32	75.50±12.97
3	15	3.61±0.42	167.4±73.16	11	3.32±0.24	149.63±34.72
4	11	2.76±0.45	120.72±53.92	9	3.15±0.46	141.55±54.17

Figure 1 Percent of time spent in MET levels in three childcare centers at baseline and follow-up (n=21).

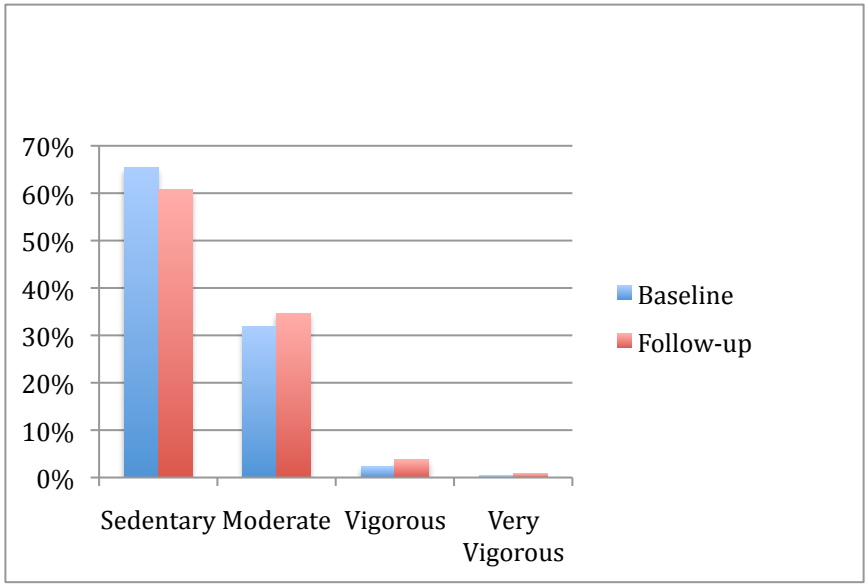
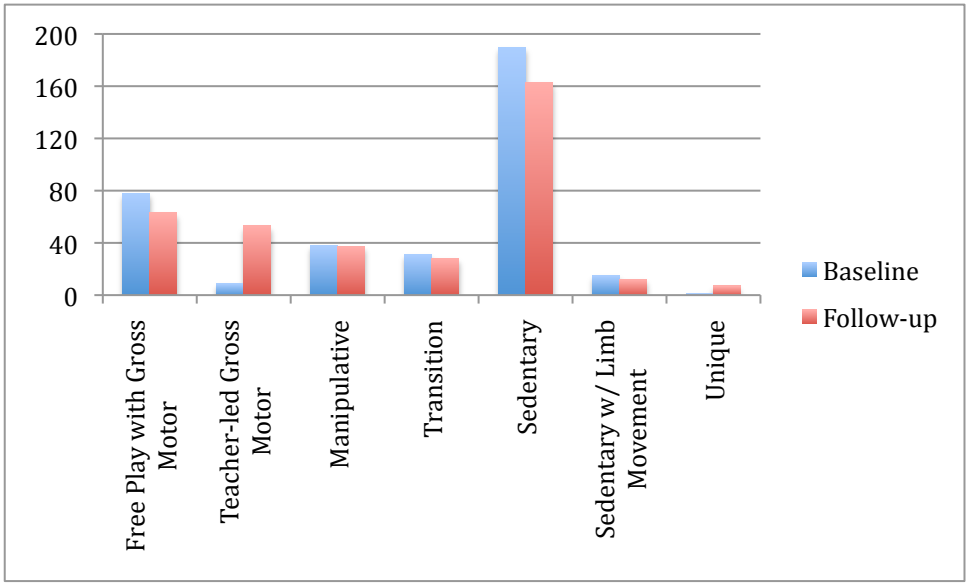


Figure 2 Average time in minutes spent in activity type at baseline and follow-up (n=21)



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Appendixes

A. Direct Observation Form

MAPLES Observer Form Observer _____ Date _____ Facility Name _____

Child A (description)		Child B (description)		Child C (description)		Child D (description)		Child E (description)	
HT	WT	HT	WT	HT	WT	HT	WT	HT	WT
AGE		AGE		AGE		AGE		AGE	

ACTIVITY LOG

Note snack times and transition times.
Using letter label assigned to each child, note participating children who may vary from what the others are doing.
Note any problems with the accelerometers. Also note time put on and time taken off each child.

Time	Inside(I) or Outside (O)	Free Play	Guided Play	Notes

B. Teacher CEC Curriculum Log

MAPLES CATCH Curriculum Teacher Log

Day 1 Activity #s used: _____, _____, _____, _____ Total Time Activity Session Took (in mins.) _____	Day 1 Activity #s used: _____, _____, _____, _____ Total Time Activity Session Took (in mins.) _____
How closely did you follow the curriculum lesson plan? **(check one)** ___ not at all ___ a little ___mostly ___completely	How closely did you follow the curriculum lesson plan? **(check one)** ___ not at all ___ a little ___mostly ___completely
Rate children's response to the activity (**circle one number**) Not at all enthusiastic Extremely enthusiastic 1 2 3 4 5	Rate children's response to the activity (**circle one number**) Not at all enthusiastic Extremely enthusiastic 1 2 3 4 5
Comments (optional)	Comments (optional)
Day 2 Activity #s used: _____, _____, _____, _____ Total Time Activity Session Took (in mins.) _____	Day 2 Activity #s used: _____, _____, _____, _____ Total Time Activity Session Took (in mins.) _____
How closely did you follow the curriculum lesson plan? **(check one)**	How closely did you follow the curriculum lesson plan? **(check one)**

C. Post Intervention Teacher Survey

Now that you have had a chance to work with the CATCH Early Childhood Physical Activity curriculum for several weeks we would like to hear your thoughts about both your participation in the MAPLES study and your use of the CATCH curriculum.

We greatly appreciate you taking the time to respond to the following questions.

1. How clear were the goals of the MAPLES project to you when you agreed to participate?

1 2 3 4 5 6 7 8 9 10

Not at all clear Very clear

2. What do you see as the main goal or objective of the MAPLES project?

Thinking about your involvement in the MAPLES study from day one (when we first invited you to participate) through the parent consent process, first measurement activity, training, intervention period, including your record keeping/logs, and final measures**:**

3. What, if anything, was the most difficult part of your involvement with the study?

4. Is there anything the University team could have done to make your involvement in the study easier or better? Please describe.

5. How well prepared did you feel when you began using the CATCH curriculum after the one day training? (Circle one number that best describes your preparation)

1 2 3 4 5 6 7 8 9 10

Not at all prepared Very well prepared

6. Has using the CATCH curriculum made you job easier or more difficult? Please explain.

7. How would you describe the children's response to this curriculum?

8. How would you describe your co-workers response to this curriculum?

9. What if anything, has been most difficult or challenging for you in using this curriculum?

10. What, if anything, have you found most valuable about using this curriculum?

11. Has using the curriculum changed your opinion in any way about daily moderate to vigorous activity for young children? If so, please describe/explain.

12. Is there anything else that you would like to comment on about your participation in this study, use of the curriculum, the record keeping that we asked you to do, etc.?